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THE USE OF DRONES IN THE BUILDING MAINTENANCE OF HIGH-RISE BUILDINGS

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ABSTRACT

Drones are a type of equipment that is widely used in many industries, including agriculture, construction, security, and building maintenance. Drones are essential for inspections for building maintenance work especially in difficult-to-reach areas such as rooftops and facades. Drones in building maintenance can reduce worker risk and provide aerial photographs that provide a better overview of the property. However, the use of drones in building maintenance is relatively low because of the drone is quite expensive and relatively new in the industry. The use of drones is very low because some building managements still aren't familiar with the importance of having and using drones in building inspections. The quantitative methods have been used in this paper using Likert scale questionnaire for data collection. A total 60 of respondents is targeted in order to reach the main objectives in this paper but only 41 respondents returned to be analysed. Results show that despite potential risks, the majority of respondents are aware of the benefits of drones. The application of drone in building maintenance are based on the importance of drone application and most of the respondents are agreed with it.

Keywords: Drones, Building Maintenance, Highrise Building

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INTRODUCTION

In the past, inspectors used cameras and eyes to identify potential defects in buildings, but this method required training, knowledge, and experience. Visual inspections were riskier and time-consuming (Nooralishahi et al., 2021). Unmanned Aerial Vehicles (UAVs), also known as drones, are a type of aircraft that can fly autonomously, collecting data from difficult and dangerous areas (Tatum & Liu, 2017). These drones are essential in facility management and maintenance departments for inspections of hard-to-reach areas, such as rooftops and facades.

The ability to retrieve visual data on hazardous geographical places quickly, safely, and affordably has sparked interest in using UAVs in facility management (McCabe et al., 2017). UAVs are small, inexpensive, and easy to control, allowing them to access any area and cut costs (Zhou & Gheisari, 2018). Additionally, drones are safe to use and can reduce the risk and time required for building inspection (Tkáč & Mésároš, 2019).

This paper presents the use of drones in building maintenance works for high rise building, and to investigate the awareness level of using drone in building maintenance works. For this purpose, the investigation was conducted by using questionnaire question and selection of three case study in Klang Valley to collect the data about the application of drone in building maintenance work for high rise building. In addition, the data were collected, and the results are discussed.

Background of Drone in Maintenance Work

Drones are increasingly popular in the construction and infrastructure industries for their ability to collect large amounts of pictorial data and monitor progress at large-scale sites in real-time (Bang et al., 2017). Building inspection is crucial for maintaining building condition, extending its lifespan, and avoiding unwanted incidents. It is applied to all types of buildings, including residential, commercial, educational, and industrial buildings. Drone technology has its roots in military purposes, with over 1400 commercial applications recorded in the construction industry. The use of drones in building maintenance can improve visual inspections, improve data collection, and replace expensive equipment during inspection routines.

However, challenges remain, such as personnel unfamiliarity, lack of knowledge, high costs, and privacy concerns. Drone maintenance is complicated due to its weatherproof nature and requires meticulous care. In conclusion, drones have the potential to revolutionize the construction and infrastructure industries by providing a more efficient and cost-effective way to inspect and maintain buildings.

LITERATURE REVIEW

Drones are a complex system consisting of detectors, computers, data link hardware, and software used for building inspection and maintenance (Pastor et al., 2006). They are non-destructive, non-damaging, and ideal for inspection work. Infrared imaging recording is another common method, but a professional pilot is needed for smooth flight and collision avoidance. Drones also offer health and safety benefits, providing efficient services to individuals in difficult-to-reach locations (Nooralishahi et al., 2021). They are suitable for many inspections due to their mobility and ability to capture footage, keeping workers safe.

Drones can be used as an alternative to make operations safer in monitoring, inspections, material transportation, and project planning. Overall, drones offer a promising solution for building inspections and maintenance, enhancing efficiency and safety in the inspection industry.

Factors of Using Drone in Maintenance Work

Drones are a popular tool in the building inspection industry, offering numerous benefits such as increased safety, cost savings, and improved safety for inspectors. They eliminate the need for hazardous situations and save companies money, resulting in reduced liability insurance costs and rental costs. Drones also reduce the risk of dangerous situations during inspection work, saving inspectors' liability insurance and temporary infrastructure costs. They are also relatively inexpensive, allowing businesses to perform more frequent inspections and identify potential problems more quickly. Additionally, drones are better at recording data, providing a meticulous record of asset condition over time, archiving visual data for future reference. Drones are a high-tech method for conducting investigations on buildings, particularly in construction and skyscrapers, making them a valuable tool for building inspections.

Challenges of Using Drone

Drone technology has significantly impacted the building inspection and construction industry, but it also presents challenges in operational safety. Increased aviation accidents and ground crashes have led to potential public safety threats, such as drone accidents falling at high heights and hitting people. The construction industry faces the challenge of endangering workers and exposing them to drone technical problems that can cause injuries (Irizarry et al., 2012). To address these risks, drones must be equipped with additional security measures to prevent accidents and ensure workplace safety. Data and connection security must be implemented to prevent hackers from accessing the drone's main control system.

Drones are also vulnerable to damage and weather effects due to unpredictable weather conditions, making them unsuitable for extreme temperatures and difficult to

control . Control complexity is another challenge in drone technology, as drones can fly without human intervention but require a remote controller if GPS is lost. Monitoring construction progress and obtaining work acceptance is more difficult when planning flight missions with a drone. Collaboration between two people is essential for a good video feed, and drone flight is easier to control than video feeds.

RESEARCH METHODOLOGY

The questionnaire was distributed to the respondents within the case study that focuses on Klang Valley representative as highrise building in Malaysia. A total of 60 targeted respondents but only 41 have returned the questionnaire. The questionnaire was distributed to the main targeted that involves building management team like, Building Manager, Building Executive, Building Maintenance Team, Technician and Building Surveyor of the building. The study was carried out the data about the importance of application drone in building maintenance work. Meanwhile, the questionnaire forms were created using Rensis Likert's Likert Scale, which was developed in 1932.

RESULT AND DISCUSSIONS

The research used questionnaire for evaluating knowledge and the importance of using drones during building maintenance work and for this paper are focus on the application of drone and the importance of drone is using Mean Ranking. Mean Ranking is the best method for comparing various options. The knowledge and their concern about the application of drone are stated in the form of mean analysis that ranked in descending orders.

The importance of using drones in building maintenance work can also be determined by using Mean Ranking to determine which option is the most effective. According to the analysis of this paper, the choice with the highest mean score is the most popular among respondents.

Application of Drone in Building Maintenance Works

Table 1 show the ranking of determining the knowledge in application of drone in building maintenance works based on the mean value. The highest mean value the more respondents agreed with it. First place with a score of 4.29 that represent two statements: drones can assist workers in performing inspections in difficult-to-reach areas prior to beginning maintenance work, and drones should only be operated and maintained by trained individuals. Followed with also two statements in second place with a score of 4.27 that drone should only be flown in secured areas and the operator of the drone must be competent to fly it. From the results, it can be agreed that most of the respondents are aware about the knowledge applying the drone in building maintenance works.

Table 1: Mean Score for Application of Drone in Building Maintenance

| No. | Statement | Mean Score |
|-----|---|------------|
| 1. | Drones can help workers perform inspections in hard-to-reach areas before starting maintenance work | 4.29 |
| 2. | Drones should only be operated and maintained by trained individuals | 4.29 |
| 3. | Drones should only be in secure areas | 4.27 |
| 4. | Operators should think about where, when, and how high or fast they'll be flying their drone or the competent person | 4.27 |
| 5. | Drone is a tool that can provide a clear image while doing building maintenance inspection for building maintenance works | 4.17 |
| 6. | The use of drone is very important when doing building maintenance work | 4.02 |

RECOMMENDATION FOR BUILDING MAINTENANCE WORK

Table 2 show the ranking of recommendation in application of drone in building maintenance works based on the mean value. The highest mean value the more respondents agreed with it. First place with a score of 4.24 that facilitating the manager's task to see any progress through the computer only and to be able to discuss with the project leader without making a physical visit. Followed with statements in second place with a score of 4.22 that drone should the data collected by the drone in one flight provides a complete map with GPS points in 2D and 3D. From the results, it can be that most of the respondents are agreed about the recommendations in implicating the drone in building maintenance works.

Table 2: Mean Score for Recommendation in Application of Drone in Building Maintenance

| No. | Statement | Mean Score |
|-----|---|------------|
| 1. | Facilitating the manager's task to see any progress through the computer only and to be able to discuss with the project leader without making a physical visit | 4.24 |
| 2. | The data collected by the drone in one flight provides a complete map with GPS points in 2D and 3D | 4.22 |
| 3. | Time and cost can be reduced | 4.22 |
| 4. | Drone technology can capture a lot of data from the air and process the data in a short time and get better results | 4.10 |

CONCLUSION

This paper aims to determine whether the building management is aware of the use of drones for maintenance work. It can be concluded that the top three of the most agreed statement in recommendation of drone application are the manager can see the results of the inspection without any physical visit, the data collected by the drone provides a complete map with GPS in 2D and 3D, and time and cost of the inspection can be reduce.

It is hoping that this research will contribute to more awareness level to all the building management team about the application of drone in building maintenance works. In line with the main objectives to determine the application of drone in building maintenance work and recommendation of improving the use of drone while doing an inspection for building maintenance work. By adding drone inspection as a new routine in building maintenance, this industry will come up to the next level.

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Tarikh : 20 Januari 2023

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